SIXTH BIENNIAL REPORT ON GREAT LAKES WATER QUALITY

"Are humans and our environment in danger from persistent toxic substances now? Are future generations in danger? Based on a review of scientific studies and other recent information, we believe the answer to both questions is yes."

International Joint Commission Sixth Biennial Report

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SIXTH BIENNIAL REPORT UNDER THE GREAT LAKES WATER QUALITY AGREEMENT OF 1978

TO THE GOVERNMENTS OF THE UNITED STATES AND CANADA AND THE STATE AND PROVINCIAL GOVERNMENTS OF THE GREAT LAKES BASIN

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SIXTH BIENNIAL REPORT

ON GREAT LAKES WATER QUALITY

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CHAPTER ONE

Introduction

As we release this *Sixth Biennial Report* on the 20th anniversary of the signing of the first Great Lakes Water Quality Agreement, society faces a daunting, unresolved challenge: dealing effectively with persistent toxic substances in the Great Lakes - St. Lawrence Basin Ecosystem. Governments and others have made considerable progress in some areas, but urgent and continuing attention is needed by all sectors of society if it is to protect the environmental integrity of the ecosystem, which includes the humans who live within and depend on it.

The principal problem is the presence and impact of persistent toxic substances on all sectors of the ecosystem. This issue defies boundaries and is not easily resolved through traditional technologies and regulations. These substances cross jurisdictional, geographic and disciplinary lines that have tended to circumscribe previous efforts to restore and protect the ecosystem. Persistent toxic substances have helped to move the term "ecosystem" from concept to reality, by forcing us to remove those imaginary lines. In their place, we are recognizing that there are no preordained boundaries in the way the natural system functions and in how humans interact with and within it. All parts of the system are now recognized as interdependent.

The International Joint Commission reports at least biennially on matters relating to water quality in the Great Lakes, including progress towards achieving the purpose and the specific provisions of the Great Lakes Water Quality Agreement. This is our *Sixth Biennial Report* to the Governments of Canada and the United States and to the State and Provincial Governments responsible for the Great Lakes basin. It is the result of advice and information from several sources. The reports of our Great Lakes Water Quality Board, Great Lakes Science Advisory Board, Council of Great Lakes Research Managers, task forces and committees prepared during the past two years provided the foundation for our conclusions and recommendations.

A complete list of these reports is provided in Appendix I. The presentations and workshops at the 1991 Biennial Meeting in Traverse City, Michigan contributed additional information, along with written submissions from a number of industrial and environmental organizations and concerned citizens. These contributions are summarized in Appendix II. We also benefitted from a series of consultations between the 1989 and 1991 Biennial Meetings, as outlined in Appendix III. We are grateful for the quality of advice received, and for the thousands of people who have become involved in Agreement activities.

The Commission has made special efforts to increase the extent and scope of its Agreement-related activities. Over the past two years, we have sponsored efforts to promote effective environmental education, sponsored zero discharge roundtables, produced a special report on exotic species, expanded efforts to increase public involvement in the work of the Commission, and become actively involved in supporting Great Lakes federal legislation. These activities and a number of other initiatives, described in more detail in Appendix III of this report, constitute what is perhaps the most productive two years of Agreement work ever undertaken by the Commission.

Focus of This Report

We focus on a few key issues in this report, for they stand far above others as significant and critical. Specifically, we address the complex and difficult problems associated with pollution of the Great Lakes Basin Ecosystem by persistent toxic substances. We believe this issue is the primary focus of the Agreement, and thus requires the concentrated and urgent attention of national, provincial, state and municipal governments.

The Agreement calls for the virtual elimination of the input of persistent toxic substances into the Great Lakes basin to protect human and environmental health. We have not yet virtually eliminated, nor achieved zero discharge of any persistent toxic substance. Indeed, persistent toxic substances such as lead, mercury and PCBs — substances known to cause injury to ecosystem health — are still legally discharged into the Great Lakes in the United States and Canada.

The Agreement also calls for the development and implementation of Remedial Action Plans to restore beneficial uses in designated Areas of Concern. While many plans have been developed, and some resources allocated to move toward implementation, many hundreds of millions of dollars will be required before Remedial Action Plans are fully implemented. A strong, continued commitment is required from all sectors of society to ensure that programs are implemented that restore and protect all Areas of Concern.

WE HAVE NOT YET VIRTUALLY ELIMINATED, NOR ACHIEVED ZERO DISCHARGE OF ANY PERSISTENT TOXIC SUBSTANCE.

The necessary commitment to environmental education in formal and nonformal settings has yet to occur in the Great Lakes region. Unless there is an increase in the extent to which environmental considerations are built into the process of values formation, and human behavior thus reflects those values, environmental progress will continue to be reactive in nature. Our educational processes must empower citizens to act responsibly towards the environment if we are to achieve the Agreement's goals.

Finally, this report focuses on management practices and on attempts to reach Agreement goals. Specifically, the Commission concludes that attempts to *regulate* persistent toxic substances have not resulted in an efficient or successful set of programs. Regulations tend to be inconsistent due to differing jurisdictional standards across the basin. They also tend to provide plenty of room for exceptions, interpretation and inconsistent application. Regulations are expensive endeavors for governments, and they have been subject to numerous legal challenges to their interpretation and implementation. Most are also reactive, in that they deal with problems once created, rather than preventing their occurrence in the first place.

Surely it is time to ask whether we really want to continue attempts to *manage* persistent toxic substances after they have been produced or used, or whether we want to begin to *eliminate* and *prevent* their existence in the ecosystem in the first place.

SURELY IT IS TIME TO ASK WHETHER WE REALLY WANT TO CONTINUE ATTEMPTS TO *MANAGE* PERSISTENT TOXIC SUBSTANCES AFTER THEY HAVE BEEN PRODUCED OR USED, OR WHETHER WE WANT TO BEGIN TO *ELIMINATE* AND *PREVENT* THEIR EXISTENCE IN THE ECOSYSTEM IN THE FIRST PLACE.

Moving from Philosophy to Reality

As discussed in our *Fifth Biennial Report* and again in this report (see chapter two), it is clear to us that persistent toxic substances have caused widespread injury to the environment and to human health. As a society, we can no longer afford to tolerate their presence in our environment and in our bodies. Their use and presence in the Great Lakes environment are also inherently inconsistent with the Agreement's purpose and specific provisions.

Hence, if a chemical or group of chemicals is persistent, toxic and bioaccumulative, we should immediately begin a process to eliminate it. Since it seems impossible to eliminate discharges of these chemicals through other means, a policy of *banning* or *sunsetting* their manufacture, distribution, storage, use and disposal appears to be the only alternative.

The *philosophy* of zero discharge thus must become a *reality* as soon as technologically possible. As the Commission has stated previously and reiterates here, a zero tolerance for the entry of any persistent toxic substance into the Great Lakes environment (including the St. Lawrence River in its entirety) from human sources should be adopted and acted on immediately by all sectors of society in order to begin to virtually eliminate all human inputs of persistent toxic substances to the Great Lakes system.

Mechanisms to achieve this end must be developed as soon as possible, including all legal, technological, economic and educational means that can be made available. These mechanisms should be developed and employed within a coordinated, interjurisdictional, binational *strategy*. The mounting

evidence of the global nature of many persistent toxic substance problems suggests the need for a global strategy for some substances, within this multilateral intergovernmental framework. Such a strategy should recognize that *all* persistent toxic substances are dangerous to the environment, deleterious to the human condition and can no longer be tolerated in the ecosystem, whether or not unassailable scientific proof of acute or chronic damage is universally accepted.

SUCH A STRATEGY SHOULD RECOGNIZE THAT *ALL* PERSISTENT TOXIC SUBSTANCES ARE DANGEROUS TO THE ENVIRONMENT, DELETERIOUS TO THE HUMAN CONDITION, AND CAN NO LONGER BE TOLERATED IN THE ECOSYSTEM, WHETHER OR NOT UNASSAILABLE SCIENTIFIC PROOF OF ACUTE OR CHRONIC DAMAGE IS UNIVERSALLY ACCEPTED.

Governmental Efforts Under the Agreement

Governments at all levels have allocated billions of dollars toward achieving the Purpose and Objectives of the 1972 and 1978 Agreements. Progress has been achieved, but much remains to be done. The Commission's previous annual and biennial reports have identified this progress and we have recommended alternative or new courses of action when programs have faltered. In many cases, the efforts by experts from governments and elsewhere in response to our reports and recommendations have led to change. Most often, these responses occur over several years of program development.

All levels of governments are beginning to work together to address the complex environmental issues facing the Great Lakes - St. Lawrence River region. They have been joined by environmental organizations, the business sector and others. The Commission applauds these efforts, especially those programs that attempt to address the intractable problems of persistent toxic substances, nonpoint pollution sources, and groundwater

and atmospheric deposition. We strongly support this trend toward integrative and targeted Great Lakes programs and urge the involvement of all sectors, including industry and the municipal and regional levels of government, in their design and implementation.

We commend the Governments for developing and at least partially implementing several recent initiatives or programs, some of which are highlighted below. These programs begin to focus on the specific concerns the Commission and many others have expressed about the state of the Great Lakes Basin Ecosystem in general, and Agreement undertakings in particular. Many of these programs are mentioned in the Parties' second biennial progress reports, as are the Parties' responses to recommendations in our *Fourth* and *Fifth Biennial Reports*. A considerable research effort also has been — and continues to be — mounted on Great Lakes - Saint Lawrence River ecosystem issues. Many of these projects are listed in the 1990-91 research inventory soon to be published by our Council of Great Lakes Research Managers. A review of the Binational Initiative to Protect Lake Superior is included in chapter three of this report.

Canadian Programs

The Great Lakes Action Plan, begun in 1989, includes two significant components. The Great Lakes Cleanup Fund contributes to Remedial Action Plan implementation, while another component, the Great Lakes Preservation Program, focuses on land-based, shipping, atmospheric and contaminated sediment sources of toxic contamination, and on ecosystem health issues. This plan responds directly to the requirements of the Agreement, particularly the 1987 amendments. It has received some funding support, although clearly not enough to meet the plan's research and implementation needs.

The Great Lakes Health Effects Program was created to meet certain human health aspects of the 1987 amendments to the Agreement. This program has incorporated an extensive public consultation process, and a wide range of research projects have been developed to examine human health effects of Great Lakes contaminants, including an analysis of contaminants in human tissue. These studies should provide a basis to assess human ex-

posure to persistent toxic substances, the effects of that exposure, and to identify individuals at risk. They also may provide additional rationale, incentive and direction for public policy decisions. They should not, however, be considered prerequisites to any action to achieve virtual elimination of inputs of persistent toxic substances into the Great Lakes - St. Lawrence River ecosystem.

There was great potential in the **Canadian Healthy Communities Programme**, developed in conjunction with similar initiatives in other countries — including the United States — under the auspices of the World Health Organization. This activity promotes and coordinates the development of "healthy communities" and has helped to demonstrate how "ordinary" citizens can take responsibility for various elements of their health, including a more sustainable relationship with their environment. This approach is consistent with Agreement goals and with the Commission's advice to expand the base of commitment to Agreement issues. It is particularly pertinent to the evolving Remedial Action Plan process. We regret that the Canadian federal government programme was ended recently, but note that the Provinces of Ontario and Québec are continuing to provide support.

The Green Plan, introduced as Canada's national environmental plan in 1990, identified several issues directly relevant to the Agreement. At least 20 percent of the three billion dollars to be spent over six years appears to be linked to Great Lakes problems. The Great Lakes Pollution Centre established in Sarnia, Ontario, for example, could be an important nucleus for Great Lakes activities. The plan has been slow in coming to fruition thus far, but the Commission looks forward to future reports outlining the improvements the plan generates in the Great Lakes Basin Ecosystem.

The St. Lawrence Action Plan was established in 1988. The plan calls for substantially reducing the liquid toxic waste discharged into the St. Lawrence River, protecting threatened species and habitats, and developing plans to decontaminate federal sites along the river. It creates a partnership among different levels of government, the private sector and universities, and includes an active public information and involvement program. When implemented, the plan will help to ensure that benefits achieved from up-

stream improvements can be realized downstream, and will assist in protecting those aquatic biota that migrate between the two segments of the ecosystem.

Several other Canadian Government initiatives are national in scope but may contribute to the accomplishment of Agreement goals. The **Environmental Partners Fund** promotes partnerships between nonprofit organizations and the federal government for local environmental projects, and the **Contaminated Sites Cleanup Fund** — for which the Governments of Canada and Ontario are still negotiating terms and identifying candidate sites — will remediate many contaminated sites in the Great Lakes region.

Under the Canadian Constitution, much of the responsibility and mandate for addressing water resource and environmental issues rests with the provincial governments. Thus, arrangements established between Ontario and the Canadian Government have been crucial to progress in Agreement-related Canadian programs. The **Canada-Ontario Agreement Respecting Great Lakes Water Quality** has been an effective coordinating and jointly funded mechanism that is an example of intergovernmental cooperation under the Agreement. We encourage the federal and provincial governments to confirm and strengthen joint programs to deal with persistent toxic substances as they undertake their review leading to renegotiation of the Canada-Ontario Agreement.

We would be remiss if we did not recognize the exemplary work to understand and apply the ecosystem concept to the waterfront of one of the major urban centres on the Great Lakes by the **Royal Commission on the Future of the Toronto Waterfront**. Even though it is not explicitly part of the Agreement framework, the Royal Commission's work echoes many of the Agreement's principles and philosophies.

Many evolving Ontario initiatives are also pertinent to the Agreement. While it is not our intention to review all state and provincial initiatives, the **Municipal-Industrial Strategy for Abatement** is worth mentioning because of its goal to virtually eliminate toxic contaminants from Ontario waterways. This program has primarily focused to date on monitoring and assessment; however, we look forward to promulgation of enforceable and effective regulations to achieve the strategy's goal.

United States Programs

In the two years following the Commission's *Fifth Biennial Report*, more Agreement-related legislation and regulations have been promulgated in the United States than at any other time since the first Agreement was signed in 1972. **The Great Lakes Critical Programs Act of 1990** adds domestic legal teeth to several Agreement provisions by ensuring that states develop and adopt consistent water quality standards, nondegradation policies and implementation procedures. It includes a schedule for completion of Remedial Action Plans, and mandates development of a Lakewide Management Plan for Lake Michigan. It also requires action to identify areas susceptible to spills of oil and other hazardous chemicals, a report on demonstration projects for contaminated sediment, and another report to Congress on the adverse effects of water pollutants on the health of humans, fish, wildlife and other species in the Great Lakes ecosystem.

To accomplish many of these requirements, a separate **Great Lakes Water Quality Initiative** was developed. It includes guidance developed by the U.S. Environmental Protection Agency for Great Lakes states to use in standardizing water quality regulations by 1994. It prohibits new pollution sources from using dilution to meet pollution standards and requires existing pollution sources to end dilution practices by 2004. It also prevents polluters from avoiding Great Lakes regulations by dumping into rivers or streams which empty into the lakes. As currently proposed, the initiative employs reverse onus for applications by new factories to discharge any of approximately 50 chemicals, and requires states to consider the effects of pollution on wildlife in setting water quality standards. This initiative is an important, positive step on the road to zero discharge and virtual elimination, and responds to many recommendations in the Commission's *Fifth Biennial Report*.

The Nonindigenous Aquatic Nuisance Prevention and Control Act mandates several federal agencies to develop and implement a program for all United States waters to prevent the introduction and dispersal of exotic species. New regulations are to be developed requiring ballast water exchange before ships enter the Great Lakes or the use of environmentally sound alternative ballast water management methods. Canadian agencies will be consulted to create an effective international program for Great Lakes - St. Lawrence River waters.

The Clean Air Act amendments contain provisions explicitly related to the Great Lakes basin. They include an assessment of atmospheric deposition to the Great Lakes and whether pollution loadings to the Great Lakes cause or contribute to exceedances of specific Agreement objectives. The legislation also mandates development of a Great Lakes Atmospheric Deposition Network.

The **National Environmental Education Act** declares that: "It is the policy of the United States to establish and support a program of education on the environment, for students and personnel working with students, through activities in schools, institutions of higher education, and related educational activities, and to encourage postsecondary students to pursue careers related to the environment."

This policy statement, coupled with the Act's provision for environmental education grants to develop, among other things, demonstration projects to foster environmental cooperation with Canada, is positive and one the Commission sees as an essential, basic approach to Great Lakes environmental education. Such projects also directly reinforce Commission activities related to Great Lakes environmental education.

These initiatives are part of the encouraging legislative and administrative movement in both countries that could lead, if their provisions are vigorously pursued and their requirements strictly enforced, to substantial progress in restoring and maintaining the integrity of the Great Lakes Basin Ecosystem. As Agreement provisions increasingly find their way into domestic legislation and programs, the commitment the United States and Canada have made to this unique and valuable international basin is strengthened and confirmed.

Other Efforts and Programs

The Commission is also aware of a growing interest in and commitment to environmental protection and sustainable development concerns in the

Great Lakes by **municipal governments**. This trend is most evident in some Remedial Action Plan programs and in the success of the annual Great Lakes - St. Lawrence Mayors' conferences. As noted in our *Fifth Biennial Report*, municipal governments have an important role to play in Agreement implementation because they are at the front line of delivering environmental programs and related infrastructure. We reiterate our concern that municipal governments should be supported by the Parties and jurisdictions as they fulfill their Agreement responsibilities.

AS AGREEMENT PROVISIONS INCREASINGLY FIND THEIR WAY INTO DOMESTIC LEGISLATION AND PROGRAMS, THE COMMITMENT THE UNITED STATES AND CANADA HAVE MADE TO THIS UNIQUE AND VALUABLE INTERNATIONAL BASIN IS STRENGTHENED AND CONFIRMED.

Several **nongovernmental organizations** have expanded their efforts on Great Lakes issues over the past 20 years. These organizations have grown considerably in their sophistication and ability to interact with other Great Lakes institutions, including governments and industry. Public consultation programs and reports produced over the past few years by these organizations have contributed greatly to the general awareness and understanding of Great Lakes issues and of the need for action. They have also strengthened and broadened the level and breadth of public and private sector commitment to the Agreement. Perhaps most importantly, the quality of research and action taken, and the level of interaction between and among all sectors of the Great Lakes community, have been enhanced by the participation of these organizations.

Industries and other businesses within the Great Lakes basin have also taken greater interest recently in Agreement work. Their more active participation in discussions and actions on Agreement-related concerns is a welcome development, as reflected in the creation and activities of the Council of Great Lakes Industries and the large attendance by business people at the 1991 Biennial Meeting. Research, policy and scientific initiatives in the

pulp and paper, plastics, petroleum, chemical, mining, metal finishing and automotive industries are also encouraging. There is clearly a need to continue these efforts to move beyond merely meeting enforceable legal requirements — as important as these may be — to an aggressive, cooperative pursuit of the Agreement's virtual elimination and zero discharge provisions. If these goals and the notion of sustainable development are to become something more than clichés, business and industry must be actively involved and committed to the Agreement's purpose and objectives.

The Commission's Council of Great Lakes Research Managers will soon publish its Great Lakes - St. Lawrence Research Inventory. The Council thus far has inventoried 378 United States Great Lakes research projects at a total funding level of $45 million and 256 Canadian Great Lakes research projects at a total funding level of $29 million.

The inventory provides much-needed baseline information about government-funded research relevant to Agreement implementation. For example, it reveals that water quality research efforts are largely concerned with the presence of toxic substances in the environment, chemical exposure, the effects of these substances on humans and other species, and techniques to clean up contaminated areas. One area identified as an obvious research gap is the transmission of health effects to progeny.

The research inventory will be useful to agencies involved in developing future policies and research agendas, and in facilitating communication among all researchers. Future editions will access and inventory research in the private as well as government sector. The inventory represents a renewed effort to track research in the basin, and as a result also assesses trends, provides data, and evaluates the responsiveness of government-funded research to emerging Great Lakes issues.

Progress under the Agreement has been accomplished as a result of efforts by various levels of government and, increasingly, by nongovernmental organizations, industries, agriculture, educators and many others. They have realized the need to seek common ground and have acted to rehabilitate the most valuable freshwater resource in the world. After 20 years of work under the Agreement, we find a set of institutions with greater matu-

rity, talent, understanding, legislative authority and public support. These factors are all necessary to achieve what is often precedent-setting progress in restoring and enhancing the Great Lakes Basin Ecosystem. The foundation has been laid to confront the problem of persistent toxic substances, a challenge that will take all of our collective ingenuity, creativity and political will if sufficient progress under this important Agreement is to be made.

AFTER 20 YEARS OF WORK UNDER THE AGREEMENT, WE FIND A SET OF INSTITUTIONS WITH GREATER MATURITY, TALENT, UNDERSTANDING, LEGISLATIVE AUTHORITY AND PUBLIC SUPPORT.

CHAPTER TWO

PERSISTENT TOXIC SUBSTANCES

Terminology

The Great Lakes Water Quality Agreement between the United States and Canada leaves no doubt as to the policy to be taken for toxic substances. It states that:

"The discharge of toxic substances in toxic amounts be prohibited and the discharge of any or all persistent toxic substances be virtually eliminated."

This statement is the cornerstone of the Agreement. Current research findings, particularly in the areas of persistent toxic substances and human health, dramatically underline the wisdom of this Agreement policy. The differences between the characteristics and effects of a toxic substance and a persistent toxic substance are fundamental to society's failure "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem." Because persistent toxic substances remain in the environment for long periods of time and become widely dispersed, and because they bioaccumulate in plants and animals — including humans — that make up the food web, the ecosystem cannot assimilate these substances. We conclude that persistent toxic substances are too dangerous to the biosphere and to humans to permit their release in *any* quantity.

WE CONCLUDE THAT PERSISTENT TOXIC SUBSTANCES ARE TOO DANGEROUS TO THE BIOSPHERE AND TO HUMANS TO PERMIT THEIR RELEASE IN *ANY* QUANTITY.

Furthermore, the Agreement calls for

"programs ... to virtually eliminate the input of persistent toxic substances in order to protect human health and to ensure the continued health and productivity of living aquatic resources and human use thereof [and] the philosophy adopted for control of inputs of persistent toxic substances shall be zero discharge."

After much discussion and reflection, the Commission concludes that the concepts of virtual elimination and zero discharge are consistent and are a clear statement or direction to take to achieve the Agreement's purpose. The overall strategy or aim regarding persistent toxic substances is virtual elimination, and the tactic or method to be used to achieve that aim is through zero input or discharge of those substances created as the result of human activity.

It might not be possible to achieve total elimination of all persistent toxic substances from the system. For example, some toxic substances — including persistent toxic substances — may be produced by, or as a result of, natural processes. The exact quantities produced are not known, but we do know that what nature produces, if unaffected by human intervention, is generally kept in a harmonious balance. Persistent toxic substances may also be released from contaminated sediments and from polluted groundwater. Because of these impediments to total elimination, our more realistic objective should be virtual elimination. It is this objective that must be realized if the Agreement purpose is to be met: the restoration and maintenance of the integrity of the waters of the Great Lakes Basin Ecosystem.

We know that it is impossible to achieve that objective — virtual elimination and restoration of integrity — if we continue to input those persistent toxic substances generated by human activities. We also know that, given our understanding of the problem, our desire to stop degrading the environment and our inherent need to protect future generations, these inputs and activities can and must be halted.

Zero discharge means just that: halting all inputs from all human sources and pathways to prevent any opportunity for persistent toxic substances to enter the environment as a result of human activity. To prevent

such releases completely, their manufacture, use, transport and disposal must stop; they simply must not be available. Thus, zero discharge does not mean less than detectable. It also does not mean the use of controls based on best available technology, best management practices, or similar means of treatment that continue to allow the release of some residual chemicals.

THUS, ZERO DISCHARGE DOES NOT MEAN LESS THAN DETECTABLE. IT ALSO DOES NOT MEAN THE USE OF CONTROLS BASED ON BEST AVAILABLE TECHNOLOGY, BEST MANAGEMENT PRACTICES, OR SIMILAR MEANS OF TREATMENT THAT CONTINUE TO ALLOW THE RELEASE OF SOME RESIDUAL CHEMICALS.

In summary, it can never be said that we can totally halt the input of persistent toxic substances into the system, or totally eliminate them. But humans can control what they do, so we can say that there should be — and shall be — zero discharge, or input, of persistent toxic substances as a result of human activities. Seen in this light, the Commission believes that virtual elimination is the necessary and reasonable goal, and zero discharge, or nil human input, is the necessary and not unreasonable tactic for achievement of the virtual elimination strategy.

The Injury

In our *Fifth Biennial Report*, we expressed concern for the injury that has occurred: persistent toxic substances have adversely affected human, environmental and economic health, and continue to do so. The evidence, which has been presented in numerous scientific and technical publications, continues to mount. Additional studies over the past two years reinforce the Commission's earlier convictions that persistent toxic substances exert far-reaching, adverse impacts throughout the ecosystem.

· The extent to which persistent toxic substances affect fish, reptile and small mammal populations raises two important questions: Are humans and our environment in danger from persistent toxic substances now? Are future generations in danger? Based on a review of scientific studies and other recent information, we believe the answer to both questions is yes.

Many compounds produced by human activity and released into the environment disrupt the endocrine (glandular) systems of fish, birds and mammals, including humans. These disruptions can be profound because the endocrine system plays a crucial role in controlling the extent and pace of the development of the individual. According to the report of a multidisciplinary group of experts,[1] substances such as DDT and its metabolites, dieldrin, PCB, dioxin, PAHs, lead and mercury, among others, have demonstrated the ability to disrupt the endocrine systems of laboratory animals, producing symptoms similar to those reported in wildlife.

DISRUPTIONS TO ENDOCRINE SYSTEMS IN WILDLIFE

Effect / Species	BIRDS	FISH	SHELLFISH	TURTLES	MAMMALS
Thyroid Dysfunction	●	●			
Decreased Fertility	●	●	●		●
Decreased Hatching Success	●	●		●	n/a
Gross Birth Defects	●	●		●	
Metabolic Abnormalities	●	●			●
Behavioral Abnormalities	●				
Demasculinization / Feminization	●	●			●
Defeminization / Masculinization	●	●	●		
Compromised Immune System	●				●

n/a = not applicable

1 Work Session on Chemically Induced Alterations in Sexual Development: The Human/Wildlife Connection, held at Wingspread, Racine, Wisconsin, July 26-28, 1991. Submitted as Exhibit No. 1 to Senator John Glenn. To be published in the Environmental Book Series, Series Editors J. Cairns and R.M. Harrison, Elsevier Applied Science Publishers, Ltd., U.K.

Patterns of effects vary among species and compounds and are dependent upon the age of the individual at the time of exposure. Thus, the chemicals may affect the embryo, fetus or perinatal organism differently than the adult. Effects are more likely to become apparent in offspring rather than the exposed parent. The timing of the offspring's exposure is crucial to the severity of these effects on character and future potential. Most troubling of all is the experts' conclusion that humans are being affected as well. Indeed, they estimate that levels of some of these chemicals measured in the human population are in the same range, and in some cases even greater, than those found in adversely affected wildlife populations. They concluded that the potential hazard to humans is great because of the likelihood of repeated and continued exposure to those chemicals known to disrupt the endocrine system.

I SEE MORE CHILDREN WHO HAVE DIFFICULTY SITTING STILL, MORE CHILDREN WHO HAVE SERIOUS DIFFICULTY PROCESSING ORAL AND WRITTEN DIRECTIONS. NO, I CAN'T PROVE THAT THESE ARE DUE TO POLLUTANTS IN THE ENVIRONMENT. CAN YOU PROVE THEY ARE NOT?

MARGARET RHINEHART PRIZER
ELEMENTARY SCHOOL TEACHER
1991 BIENNIAL MEETING

Establishment of a direct link between environmental concentrations of a persistent toxic substance and damage in a living species was the subject of other workshops[2] held in 1989 and 1991. In presentations of numerous case studies based on information derived from field investigations, unequivocal evidence was presented to confirm cause-effect linkages between specific persistent toxic substances and specific adverse impacts in fish, birds, turtles and various mammals. The culprit chemicals include PCB, DDT and its metabolites, dieldrin, dioxin and polynuclear aromatic hydrocarbons.

2 *Proceedings of the Workshop on Cause-Effect Linkages*, held March 28-30, 1989 in Chicago, Illinois. M. Gilbertson, editor. Council of Great Lakes Research Managers, International Joint Commission, Windsor, Ontario. 1990.
Cause-Effect Linkages II, Symposium Extracts, held September 27-28, 1991 in Traverse City, Michigan. S. Schneider, editor. Michigan Audubon Society. 1991.

The United States General Accounting Office (GAO) also studied this subject and issued its report in October 1991.[3] Specifically, the GAO was asked to identify environmental chemicals of high concern as reproductive and developmental toxicants; the extent of regulation in place to deal with these chemicals; the degree to which regulations are based on reproductive and developmental toxicity; and the extent to which regulations are sufficient to protect humans against reproductive and developmental disease. The GAO's findings were not encouraging.

The study concluded that no federal United States agency has listed chemicals known or suspected to be toxic to human reproduction and/or development. To pursue its study, the GAO identified its own list of 30 chemicals known or suspected to have adverse reproductive and developmental effects on humans. The GAO found that, while regulatory action exists for all but one of the 30 chemicals, actions related to air and consumer products are poorly covered. Two-thirds of the relevant regulatory decisions are based on such considerations as cancer and acute toxicity, rather than on reproductive and developmental toxicity levels. The GAO concluded that the degree of protection offered to the public against reproductive and developmental disease as a result of toxic exposure is uncertain at best.

A Government of Canada report[4] released in March 1991 reported that *"toxic chemicals found in the Great Lakes can have subtle effects on cellular metabolism."* These *"may not be adverse health effects in themselves and their ability to predict the eventual occurrence of adverse health effects is unclear."* Nonetheless, such subtle effects *"are undesirable and support the need for a reduction in our exposure to such substances."*

The report further noted that human and wildlife populations in the Great Lakes basin are exposed to similar chemicals. While only limited data are available on human health effects, there is a considerable body of information about effects in wildlife. Data for both wildlife and humans

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3 *Reproductive and Developmental Toxicants. Regulatory Actions Provide Uncertain Protection.* Report to the Chairman, Committee on Governmental Affairs, U.S. Senate. United States General Accounting Office, Washington, D.C., October 1991. Report No. GAO/PEMP-92-3. 116 pp.

4 *Toxic Chemicals in the Great Lakes and Associated Effects.* 2 Vols. and Summary. Environment Canada, Department of Fisheries and Oceans, and Health and Welfare Canada, March 1991. Available from: Department of Supply and Services, Ottawa. Cat. No. En 37-95/1990-1E. Aussi disponible en français.

"... suggest that developmental effects occur in the offspring of exposed parents, rather than in the parents themselves. Studies of wildlife populations suggest that more emphasis should be placed on studying effects on embryonic development, biochemical processes, reproduction and neurobehavioural development in humans. There are sufficient data to conclude that some highly exposed or very sensitive human populations in the Great Lakes basin are at risk even if the precise nature and the extent of the threat to health are unclear."

Many different perceptions exist about the nature and extent of the threat of persistent toxic substances. Consequently, there is disagreement about the nature and timing of various elimination strategies. For example:

- Which substances are so egregious that they must be immediately banned?

- Which substances are persistent and toxic and should therefore be subject to zero discharge, leading to virtual elimination?

- Which remedial and preventive measures are necessary and sufficient?

- Which sources and pathways should be included in a virtual elimination strategy?

- What are the indicators of progress toward achievement of virtual elimination?

The Commission recognizes that scientific data are open to interpretation and that, notwithstanding the confirmed cause-effect link in some cases, unequivocal conclusions may be difficult to reach in others, especially if individual studies are considered in isolation. With low contaminant concentrations, subtle effects and potentially confounding factors, unequivocal evidence of injury to humans by persistent toxic substances may be difficult or impossible to obtain.

Critics have attempted to find flaws with individual studies in order to discredit findings and conclusions about persistent toxic substances. While limitations to study design may exist, this does not necessarily invalidate the

THE URGENT NEED IS FOR EFFECTIVE PROGRAMS TO ACHIEVE VIRTUAL ELIMINATION.

findings and conclusions when considered in a weight-of-evidence context. At some point, the emerging mass of data and information must be accepted as sufficient to prompt or, in the case of the Agreement, ratify action against environmental contaminants. Therefore, the Commission has adopted a "weight-of-evidence" approach. Taking the many studies that indicate injury or the likelihood of injury together, we conclude that the evidence is sufficient that many persistent toxic substances are indeed causally involved, and there can be no defensible alternative: their input to the Great Lakes must be stopped. The urgent need is for effective programs to achieve virtual elimination.

The confirmed cause-effect linkages and weight of evidence approach have profoundly altered how society perceives and is now responding to persistent toxic substances. This approach needs to be applied to other suspected substances to determine which of them are also persistent and toxic and should, therefore, be subject to the Agreement requirements of zero discharge and virtual elimination. **The Commission recommends that:**

1. **the Parties adopt and apply a weight-of-evidence approach to the identification and virtual elimination of persistent toxic substances.**

We recognize that problems associated with persistent toxic substances cannot be simply defined or solutions easily implemented. The return of the bald eagle to some areas of the Great Lakes basin illustrates the complexity of the problem.

The bald eagle is an extremely sensitive monitor of ecosystem quality. This has been affirmed by experts convened under the Commission's auspices.[5] Nesting pairs reintroduced to the north and south shores of Lake Erie

5 *Proceedings of the Expert Consultation Meeting on Bald Eagles.* D.A. Best, M. Gilbertson and H. Hudson, editors. International Joint Commission, Windsor, Ontario, 1991.
Third Expert Consultation Meeting on Bald Eagles in the Great Lakes Basin. International Joint Commission, Windsor, Ontario, February 25-26, 1992.
T. Colborn. "Epidemiology of Great Lakes Basin Eagles." *Journal of Toxicology and Environmental Health*, 33:395-459, 1991.

continue to survive, which can be seen as evidence of improved ecosystem quality. The viability of many of their eggs also attests to improvements. However, in 1991, 8 of 12 hatchlings in Ohio nests died of wasting by the age of four weeks, a syndrome linked with persistent toxic substances. This would indicate that while we have made substantial progress to reduce some contaminant levels over the past 10 to 15 years, this progress has not been sufficient to restore the viability of bald eagle chicks in this and other populations of bald eagles nesting near the shoreline of the Great Lakes.

PCB contaminant levels in the ecosystem improved considerably in the mid-to-late 1970s as a result of reductions in inputs which, in turn, were due to a voluntary ban and later prohibition on the manufacture and certain uses of PCBs. However, little if any improvement has occurred in the 1980s, and no evidence has been presented that change is likely in the 1990s and beyond. The situation is complex, but there are at least two contributing factors:

- Contaminants are continuously released from sediment as the system slowly purges itself; and

- PCB inputs are continuing as a result of continued use, ineffective storage, and past and present disposal practices. More than half the PCBs produced are still in use or are in storage and disposal sites and thus have the potential to enter the Great Lakes environment.

A major flood in the Saginaw River basin in 1986 illustrates the degree to which contaminants remain in the ecosystem, the ease with which they can be remobilized from sediment and their devastating impacts felt. Following the flood, the 1987 hatch rate of Caspian terns in the area dropped precipitously, by more than 70 percent. None of the chicks that hatched survived more than five days. Examination of these eggs showed a marked increase in embryo deaths and abnormalities, and some live young showed developmental deformities. The chemicals found to cause these effects were PCBs, with some contribution from PCDD and PCDFs (polychlorinated dibenzo-para-dioxins and dibenzofurans). Hatchability in this Caspian tern colony only exhibited recovery after three more breeding seasons.

Similar instances of inadvertent releases of contaminants to the environment have occurred through groundwater, atmospheric deposition, spills, fires and other accidents. These sources must be eliminated to ensure zero discharge and achieve virtual elimination of the inputs of persistent toxic substances.

A Prescription for Restoration and Protection

The foregoing raises three fundamental questions:

- What additional measures can be taken within the existing institutional framework and philosophy to achieve virtual elimination?
- Can these actually deliver virtual elimination?
- What new thinking and directions are necessary?

These questions and the perspectives presented above have been and continue to be addressed by the Commission's Virtual Elimination Task Force. While the Task Force will not submit its final report until 1993, its work to date and other information have helped us reach several conclusions.

The Commission commends governments, industry and others for the accomplishments to date, and for the programs underway to control and prevent the release of contaminants. More stringent application of existing laws, technology and economic instruments can lead to further improvements in ecosystem quality, especially if all sources and pathways by which persistent toxic substances enter the environment are considered, and if all media — water, land, sediment, air and biota — are addressed together.

The existing framework and philosophy are, however, targeted largely toward control of those toxic substances that the environment can assimilate. This approach has been successful in reducing inputs and ambient concentrations of some persistent toxic substances. Nevertheless, because of persistent toxic substances' unique properties, this institutional framework and

philosophy cannot, in our view, deliver virtual elimination. Fundamental changes are required, changes that complement — not supplant — existing procedures.

It is not possible to remove a persistent toxic substance from a source completely once that substance has been produced. Nor is it possible to retrieve that substance completely once it has entered the environment. Therefore, the focus must be on preventing the generation of persistent toxic substances in the first place, rather than trying to control their use, release and disposal after they are produced. Technology applied at the end of a pipe attempts to control the release of persistent toxic substances. Changes to feedstocks, production processes or the finished products themselves can prevent the production and use of the substances and thereby eliminate such releases.

THEREFORE, THE FOCUS MUST BE ON PREVENTING THE GENERATION OF PERSISTENT TOXIC SUBSTANCES IN THE FIRST PLACE, RATHER THAN TRYING TO CONTROL THEIR USE, RELEASE AND DISPOSAL AFTER THEY ARE PRODUCED.

To prevent further inputs, bans on production and imports are necessary, but not adequate on their own. Likewise, removal from use with subsequent storage and disposal will not solve the problem. Rather, we must confront the entire life cycle of a persistent toxic substance.

"Sunsetting" is a comprehensive process to restrict, phase out and eventually ban the manufacture, generation, use, transport, storage, discharge and disposal of a persistent toxic substance. Sunsetting may require consideration of the manufacturing processes and products associated with a chemical's production and use, as well as of the chemical itself, and realistic yet finite time frames to achieve the virtual elimination of the persistent toxic substance.

Effective sunsetting also requires a cooperative approach whereby the traditional regulatory approach is blended with consultation and dialogue among

all stakeholders, using a range of mechanisms and partnerships. The Commission sees signs of change in institutional arrangements, such as the Pollution Prevention Initiative, the formation of the Council of Great Lakes Industries and the industry-nongovernmental organization New Directions Group. These partnerships should be nurtured and encouraged, as they will help to deliver virtual elimination.

The definition of a *persistent* toxic substance is critical, because it prescribes which chemicals should be completely eliminated from all sources and pathways and those for which less stringent controls may be sufficient. Annex 12 of the Agreement defines a persistent toxic substance as

> *"Any toxic substance with a half-life in water of greater than eight weeks."*

Half-life is defined as

> *"the time required for the concentration of a substance to diminish to one-half of its original value in a lake or water body."*

The Commission recommends that:

2. **the Parties expand the definition of a persistent toxic substance to encompass all toxic substances:**

- **with a half-life in any medium — water, air, sediment, soil or biota — of greater than eight weeks, as well as**

- **those toxic substances that bioaccumulate in the tissue of living organisms.**

The Commission has carefully considered what actions are required to deal with those persistent toxic substances known to cause injury. In particular, we have focused on the 11 Critical Pollutants identified by our Great Lakes Water Quality Board in 1985. While these pollutants have been subjected to a wide range of government and industrial controls, their concentrations persist at unacceptable levels in the Great Lakes environment. Actions to date thus are not sufficient. These chemicals fall into three categories:

- Intentionally produced chemicals (PCB, DDT, dieldrin, toxaphene, mirex, hexachlorobenzene);

- Production byproducts (TCDD, TCDF, benzo(a)pyrene, hexachlorobenzene); and

- Metals (lead, mercury), whose availability has been enhanced by human activity.

PCBs are no longer manufactured or imported into the United States and Canada, but they are still widely used and sizeable quantities are in storage and disposal facilities in both countries. DDT is still produced in large quantities and used in other countries; it may enter Canada and the United States by atmospheric transport. There appear to be continuing local inputs of DDT from unknown sources.

While production and use of dieldrin and toxaphene were effectively halted 10 to 15 years ago, the use of small quantities of the former is still permitted. Their continued presence in the Great Lakes environment is due primarily to their persistence, to environmental recycling, and possibly to groundwater and atmospheric transport from Central America. Likewise, mirex has been effectively banned; again, persistence and recycling, augmented by groundwater-borne inputs from waste disposal sites along the Niagara River, likely account for its continued presence in Lake Ontario fish.

Use of hexachlorobenzene as a pesticide and as an industrial chemical has declined in recent years. However, it is still inadvertently produced during the manufacture of several chlorinated chemicals. It also has been detected in the flue gas and the fly ash of municipal incinerators; because the use of incineration is increasing, emissions of hexachlorobenzene are expected to increase.

Actions to date have not been sufficient to virtually eliminate the input of these six persistent toxic substances. To restore and protect the Great Lakes ecosystem and to achieve the provisions of the Agreement, sunsetting — a program of staged reductions, leading to the total and complete ban on manufacture, generation, use, transport, storage, discharge and disposal — is

necessary for these substances. In some cases, an immediate ban may be necessary. Consistent with Agreement provisions regarding persistent toxic substances and with mounting evidence showing the injury to the ecosystem and humans as a result of exposure to these chemicals, **the Commission recommends that:**

3. **the Parties sunset PCBs and seek public acceptance of the means to effect their destruction.**

4. **the Parties sunset DDT, dieldrin, toxaphene, mirex and hexachlorobenzene and, in particular, seek an international ban on their production, use, storage and disposal.**

In addition to being intentionally produced, hexachlorobenzene is an undesired byproduct of the production of other chemicals. Dioxins and furans are also undesired byproducts of the use of other chemicals. **We therefore recommend that:**

5. **the Parties, in consultation with industry and other affected interests, alter production processes and feedstock chemicals so that dioxins, furans and hexachlorobenzene no longer result as byproducts.**

Under natural conditions, mercury and lead do not pose a threat in most instances to human and aquatic ecosystem health. However, anthropogenic use has significantly increased their mobility and availability, with consequent injury. Significant steps have been taken to reduce some uses, such as lead in gasoline and mercury in the chlor-alkali industry, but other uses are widespread. For example, coal combustion for electric power generation and disposable batteries are both sources of mercury. **Therefore, the Commission also recommends that:**

6. **the Parties review the use of and disposal practices for lead and mercury, and sunset their use wherever possible.**

In 1986, the Water Quality Board developed a working list of 362 chemicals confirmed to be present in the water, sediment and/or biota of the Great Lakes Basin Ecosystem. Approximately half of these substances are

synthetic chlorinated organic substances. In addition, there are other chlorinated organic substances entering the environment that have not yet been separately identified. Even though many of these substances have not been proven to be individually toxic, it is likely that many of these chemicals — because of their chemical characteristics — will be identified as persistent toxics and hence substances to be virtually eliminated and subject to zero discharge.

ACCORDINGLY, THE COMMISSION CONCLUDES THAT THE USE OF CHLORINE AND ITS COMPOUNDS SHOULD BE AVOIDED IN THE MANUFACTURING PROCESS.

There is a growing body of evidence that these compounds are at best foreign to maintaining ecosystem integrity and quite probably persistent and toxic and harmful to health. They are produced in conjunction with proven persistent toxic substances. In practice, the mix and exact nature of these various compounds cannot be precisely predicted or controlled in production processes. Thus, it is prudent, sensible and indeed necessary to treat these substances as a class rather than as a series of isolated, individual chemicals. Further, in many cases alternative production processes do exist.

This approach raises the question as to whether the use of chlorine, the common precursor for the production of chlorinated organic substances, should be sunset. We know that when chlorine is used as a feedstock in a manufacturing process, one cannot necessarily predict or control which chlorinated organics will result, and in what quantity. Accordingly, the Commission concludes that the use of chlorine and its compounds should be avoided in the manufacturing process. We recognize that socio-economic and other consequences of banning the use of chlorine — and subsequent use of alternative chemicals or processes — must be considered in determining the timetable.

The Commission also recognizes that certain other uses of chlorine are of special concern because of the overwhelming public health benefits from their use. Disinfection of drinking water and sewage (as well as production

of certain pharmaceuticals) are uses for which public health has been protected and for which, it is claimed, there are limited or no alternatives. Yet, there is evidence that chlorinated organics are created in water treatment processes and that, in other parts of the world, alternative processes have long been in use. Again, the issue seems to be cost rather than technology.

The Commission therefore recommends that:

7. **the Parties, in consultation with industry and other affected interests, develop timetables to sunset the use of chlorine and chlorine-containing compounds as industrial feedstocks and that the means of reducing or eliminating other uses be examined.**

CHAPTER THREE

LAKE SUPERIOR AND ZERO DISCHARGE

In drafting its *Fifth Biennial Report*, the Commission recognized that the Agreement philosophy of zero discharge of persistent toxic substances had to become more than a slogan. To realize this philosophy, we concluded, two questions had to be answered: Zero discharge of what? Zero discharge where?

We suggested an answer to these two questions in the *Fifth Biennial Report*. We recommended that Lake Superior be designated *"a demonstration area where no point source discharge of any persistent toxic substance will be permitted."* Over the past two years, no other recommendation has generated more enthusiasm and hard work on the part of governments, nongovernmental organizations and individuals to develop such a program.

For their part, Governments were explicit in their response to the Commission and the public. In an October 1, 1991 public release titled *A Binational Program to Restore and Protect the Lake Superior Basin*, Governments stated:

. . . WE ARE LIMITED BY THE AVAILABILITY OF PAPER PRODUCED WITHOUT THE USE OF DANGEROUS POLLUTANTS. MOST OF OUR PAPER SUPPLIERS ARE FAR ALONG WITH THEIR PLANS TO ELIMINATE CHLORINE-BLEACHED PULP. WE WILL USE THIS ALTERNATIVE PAPER AS SOON AS IT IS PRACTICAL TO DO SO.

TIME MAGAZINE
JANUARY 20, 1992

"The challenge to designate Lake Superior as a 'demonstration area where no point source discharge of any persistent toxic substance will be permitted,' is accepted."

Thus, the Governments of Canada and the United States, in cooperation with Michigan, Minnesota, Wisconsin and Ontario, committed themselves to take immediate steps to restore and protect the Lake Superior basin, with emphasis on special designations, pollution prevention and enhanced regulatory programs.

The binational program contains a number of specific provisions to reduce and eliminate point source discharge of persistent toxic substances to Lake Superior. It also includes provisions for a multi-media approach to Lake Superior protection. The United States will require best management practices where nonpoint sources significantly impair water quality. Further, the 1991 revision to the U.S. Clean Air Act requires necessary emission standards or control measures to protect Lake Superior by 1995. Ontario will prepare new and revised regulations to reduce and eliminate point source discharges of persistent toxic substances, and will incorporate pollution prevention, multi-media considerations and the philosophy of zero discharge in its recommendations.

Because atmospheric deposition is a major pathway contributing to the pollutant load of Lake Superior, the Parties' plans include studies in this area. The Commission awaits details which, with the assistance of its International Air Quality Advisory Board, we will evaluate for their efficacy. In June 1990, Canada and the United States also signed an implementation plan for the Integrated Great Lakes Atmospheric Deposition Network, which is designed to detect and identify airborne toxic substances and to estimate loadings to the lake and its basin.

The Commission strongly supports the Parties' efforts to expand the Lake Superior initiative to include nonpoint and atmospheric sources. We also urge that programs to prohibit point source contributions of persistent toxic substances to Lake Superior not be delayed while definitions of problems associated with, and programs to remedy other sources, are pursued. Further, we believe a program to eliminate point sources of persistent toxic

substances must include several additional concrete steps.

The Parties' current program to restore and protect the Lake Superior basin is an admirable undertaking that deserves public support. However, it apears to have a more limited objective to reduce and manage — rather than to eliminate — the point source discharges of persistent toxic substances. A program to bring about zero discharge must include a target date to end point source discharges of persistent toxic substances. If such a target is not established, we will always be "on the way" to zero discharge, but will never quite arrive. **Therefore, the Commision recommends that:**

8. **the Parties, in cooperation with Lake Superior states and provinces, establish a specific date at which no point source release of any persistent toxic substances will be permitted into Lake Superior or its tributaries.**

The U.S. Great Lakes Water Quality Initiative, as previously noted in chapter one, calls for prohibiting new sources of pollution from using dilution to meet water quality objectives. The initiative also would require phaseout of the use of dilution to meet objectives by existing United States plants by 2004, and calls for new standards that require discharges of persistent toxic substances to be below detection levels when measured at the end of the pipe. Canada has also announced that it will participate in the Lake Superior Initiative under the direction of its new Great Lakes Pollution Centre in Sarnia. While these measures by themselves will not bring about zero discharge, they will help to establish consistency among regulatory regimes, which will make it difficult for industries to identify a jurisdiction with less stringent standards.

IF EITHER NATION OR ANY JURISDICTION BORDERING LAKE SUPERIOR ABIDES BY AN APPROACH LESS STRINGENT THAN THAT OF ITS NEIGHBORS, THE LAKE SUPERIOR PILOT PROGRAM WILL NOT SUCCEED.

THE PROGRAM SHOULD PROVIDE A CRITICAL *TRIAL RUN* FOR BROADER-SCALE PROGRAMS THAT COULD BE APPLICABLE TO THE REST OF THE BASIN AND ELSEWHERE IN THE UNITED STATES AND CANADA.

A level playing field is important for the Parties to develop jointly with all Lake Superior jurisdictions. If either nation or any jurisdiction bordering Lake Superior abides by an approach less stringent than that of its neighbors, the Lake Superior pilot program will not succeed. For example, the recent decision by Ontario to approve a two-year delay in the construction of a secondary treatment facility on Lake Superior illustrates how the decision of one state or province could be seen by other jurisdictions as an attempt to gain competitive advantage for an industry within its borders. **The Commission thus recommends that:**

9. **the Parties, in cooperation with Lake Superior jurisdictions, agree to prohibit new or increased sources of point source discharges of persistent toxic substances, and establish a coordinated, planned phaseout of existing sources.**

The program should provide a critical "trial run" for broader-scale programs that could be applicable to the rest of the basin and elsewhere in the United States and Canada. For this reason and for the other considerations noted above, the Lake Superior recommendation to eliminate the point source contributions of persistent toxic substances to Lake Superior should be vigorously pursued by the Parties.

CHAPTER FOUR

FURTHER STRATEGIES TO SUSTAIN THE GREAT LAKES BASIN ECOSYSTEM

Any effective strategy to deal with persistent toxic substances will require broad-based, multi-faceted cooperation and a long-term commitment by all sectors of society. Such a strategy should be led by the Parties but should not be their exclusive responsibility. It is essential, in fact, that all interests actively contribute to the strategy, and deal with issues broadly rather than parochially to ensure the strategy's full implementation. No one economic sector, region or jurisdiction should carry an unreasonable share of the burden.

Partnerships

Ideally, such a strategy would replace adversarial approaches so that polluters accept direct responsibility, and governments accept a leadership role to bring about consultation and implementation of targeted, cooperative measures. If consultative, cooperative endeavors do not work, then stringent measures may need to be developed and strictly enforced. Nonetheless, a more cooperative, community-based resolution process should be the preferred strategy, one that leads to a partnership among all levels of governments, industry, the broader business sector, various other professional, community and special interest organizations, and citizens. This partnership would help to resolve pressing societal concerns such as the dangers posed by our continuing use and abuse of persistent toxic substances.

We are heartened to see that recognition of this challenge is spreading, as manifested in the attendance of virtually all critical sectors of society at the Commission's 1991 Biennial Meeting. The formation of processes or forums such as the provincial and local roundtables in Canada, the 33/50

project for pollution prevention in the United States, and the consultative mechanisms leading to the Lake Superior Initiative are also encouraging.

Consumer and Community Education

An important element in the strategy to deal with persistent toxic substances, and Agreement requirements and environmental values generally, is education. As related in our *Fifth Biennial Report* and our *Special Report on Great Lakes Environmental Education*, children need to develop a respect for environmental stewardship and a sustainable life style, and educators must be equipped to help develop that understanding. Effective environmental education is central to any effort to create a sustainable environment for future generations. When we speak of environmental education, we mean a process not confined to reciting facts and transmitting information, but one that helps people develop critical thinking skills and motivates them to seek the best decisions and actions for themselves and for society.

EFFECTIVE ENVIRONMENTAL EDUCATION IS CENTRAL TO ANY EFFORT TO CREATE A SUSTAINABLE ENVIRONMENT FOR FUTURE GENERATIONS.

Children must begin learning about environmental values in kindergarten through grade eight, because that is when values are formed. Adults, however, can learn to alter behaviors they may have developed decades ago. Education programs that target groups such as health professionals, industrial, marine and municipal equipment operators, farmers and business executives, for example, during their formal education and on a continuing basis, should be an additional focus of attention.

Some progress in environmental education has occurred. However, a dedicated effort to incorporate the Great Lakes into curricula in the region is still lacking. Thus, the Commission reiterates our previous recommendations, presented in our *Special Report on Great Lakes Environmental Education*, that:

- the Parties encourage the jurisdictions to cooperatively develop and implement an interjurisdictional agreement to increase the emphasis given to, and the number and quality of programs developed for, environmental education at all age and grade levels;

- Governments encourage and provide financial support for the establishment of a clearinghouse on environmental education materials and curricula. A Great Lakes Education Clearinghouse could be established in a location accessible to Canadians and Americans through mail, telephone, computer or in person. Such a clearinghouse could be established at a university, a nonprofit educational organization or similar entity to provide materials on database or hard copy, and would serve as a mechanism to publicize and widely distribute educational materials about the Great Lakes-St. Lawrence environment;

- Governments encourage and provide financial support for the development of environmental education curriculum guidelines for all grades, levels and subjects in the Great Lakes-St. Lawrence basin school systems;

- funds be provided through the U. S. National Environmental Education Act and specifically earmarked for development of classroom ready, hands-on curricula for teachers at all grade levels and in a variety of subject areas. Similarly, funds should be provided to support development of materials to suit curriculum guidelines when established in Ontario and Quebec. Further, educators should play a key role in developing these materials; and

- the Parties encourage the jurisdictions, and through the jurisdictions the school systems, to provide financial support for and coordination of teacher training programs aimed at developing environmental education skills and fostering the necessary teacher confidence to effectively teach interdisciplinary environmental education programs.

We further recommend that:

10. **the Parties, in cooperation with Great Lakes jurisdictions, develop and implement educational programs that incorporate the Great Lakes and ecosystem considerations into existing curricula and educational programs at all age levels.**

In response to society's changing values, an increasing number of firms are producing and marketing environmentally friendly processes and products. In some cases, firms are responding to the demands of more environmentally sophisticated consumers. In others, they are incorporating genuine corporate concern for the environment. However, standards do not exist for phrases such as "green," "clean" or "pollution free," phrases that may in some cases simply reflect environmental public relations.

The environmental impact of consumption choices deserves more attention. Labelling programs such as the Canadian "Environmental Choice" product logo should inform consumers of the environmental impact of their choices, both for the product itself and its packaging. We believe these programs merit further exploration and clarification to ensure that consumers are fully informed of the impacts of their decisions as they share in the responsibility for achieving a healthy ecosystem.

Remedial Action Plans

One area where environmental partnerships are developing some credence and impact is in the Remedial Action Plan (RAP) process. While the partnership approach unfortunately is not being used in all Areas of Concern, several are viewing RAPs as opportunities to integrate planning and management of resources in their harbor or bay areas. In Toledo, Ohio, for example, the Maumee River RAP is considered more than a regulatory instrument imposed from above. Rather, the process brings together all elements of the community, including state and municipal officials from various agencies, industry, farmers, educators and others, to jointly develop solutions to their unique problems. Hamilton Harbour has also had an active stakeholder group involved throughout its RAP development process. These activities, where adequately focused and supported, are extremely effective in marshalling community attention on the issues and, hopefully, long-term support for implementation of corrective measures.

In many Areas of Concern, real progress has been made to develop plans and begin remedial programs. Major investments for combined sewer separations, nonpoint programs, hazardous waste site controls, contami-

nated sediment remediation and habitat restoration are a few of the actions taken thus far. While this progress is significant, major new investments and long-term commitments to remedial and preventive programs will be required, particularly from governments at all levels, industry, land developers and the public in each Area of Concern. We are particularly concerned that further progress is required to develop integrative, coordinated and comprehensive RAPs in the binational, shared waters of the connecting channels. We are investigating their complexities and difficulties and will report on them in a separate report.

IN MANY AREAS OF CONCERN, REAL PROGRESS HAS BEEN MADE TO DEVELOP PLANS AND BEGIN REMEDIAL ACTIONS.

The Commission has completed commentaries on 25 Stage 1 RAP submissions over the past four years, one of which we believe also substantially met Stage 2 requirements. It has been our consistent observation that a broad, meaningful public and interest-group involvement process from the outset is essential to a comprehensive and implementable RAP. Demographic and socio-economic considerations with respect to causes and potential benefits also must be included in the analysis. In general, neither subject has been described well in submitted RAPs, even when exemplary programs are in place. Given the importance of both elements to the RAP process, additional efforts could be made to expand discussions in future plans submitted for review.

It is also rare that RAPs explicitly recognize the obligation within the Agreement to strive for virtual elimination within a philosophy of zero discharge of persistent toxic substances. While full implementation of programs to restore the 14 listed beneficial uses would undoubtedly lead to the drastic reduction — and perhaps virtual elimination — of persistent toxic substances, this objective needs to be more directly recognized in the RAP process if these programs are to become a part of the overall virtual elimination strategy. This is desirable not only on its own merits, but also because RAPs are leading the way to more effective, integrative approaches to deal with Agreement issues. Likewise, Lakewide Management Plans being de-

veloped for the open waters of the Great Lakes also must recognize the obligation to strive for virtual elimination within a philosophy of zero discharge of persistent toxic substances.

Despite these general deficiencies, further advancement of the RAP process should proceed in those areas where problems and their causes have been clearly identified. Identification and implementation of remedial and preventive measures in such areas should proceed without delay, even as additional data and analysis are provided to fill information gaps.

The Commission continues to encourage governmental and nongovernmental entities, at all levels, to move forward to implement and provide adequate funding for RAP programs. We intend to prepare a special report in the near future, which will further address progress on RAPs generally and on the particular issues noted here.

Protection for Special Areas

While restoring polluted areas in the Great Lakes basin has been the major thrust of Agreement work to date, the Agreement's nondegradation policy also emphasizes protection for areas of high quality. Certain areas around the Great Lakes have historically received protection and/or specialized management attention through such designations as federal, state/provincial and local parks, wildlife reserves, land conservancies, national lakeshores, and Biosphere Reserves designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Little if any concerted attention has been given, however, to coordinating these efforts, identifying common concerns and management criteria, or sharing information. Nor have specific programs of the Parties to systematically protect areas of high quality and biosystemic importance been enunciated.

In 1989, our Great Lakes Science Advisory Board suggested that selected high quality areas in the coastal zone be identified and further protected within a basinwide system and ecosystemic perspective. Such sites could form a useful series of "benchmarks" against which to monitor and assess the continuing impacts of human activity on the natural environment

and on its specific components. The Board further suggested that such a program could have significant educational and research value, and could focus public attention on the great natural heritage of the lakes. The evolution of the Board's concept was presented at the 1991 Biennial Meeting through a resolution from a number of parliamentarians and congressmen supporting the designation of a Great Lakes Biological Reserve under the UNESCO Man and the Biosphere (MAB) program.

Experience with MAB Biosphere Reserves has varied but is generally positive. Reserves have tended to involve relatively small areas of sufficient environmental quality and biosystemic interest to merit international designation and special protection. They should also have the potential for development of effective demonstration, research and monitoring programs. Management of these areas usually requires cooperation among private interests and a variety of governmental agencies at all levels, although core areas of many designated sites in North America lie within areas managed by agencies such as the National Park Service. Forty sites are designated in the United States and six in Canada, with four in the Great Lakes basin (two in each country).

Two proposals for areas in Lake Superior appear to have some potential. One proposal is to designate part or all of the deep waters of Lake Superior which retain high quality water as reserves with areas of particular importance to lake trout and other biota. The remainder of the Lake Superior drainage basin would be designated as a buffer zone and zone of cooperation. This is an innovative concept, partly because the designation is for an aquatic rather than a terrestrial core. It is consistent with the Agreement's purpose and undertakings, including the existing application of ecosystem objectives (lake trout and Pontoporeia hoyi). It may also be consistent with and contribute to global agendas emerging from the United Nations Conference on Environment and Development, to be held in Brazil in June 1992.

A second proposal, under discussion by the Canadian and United States MAB Committees, would develop a series or "chain" of small Biosphere Reserves centered on existing conservation areas such as the national and provincial/state parks and wildlife refuges. This proposal would build directly on existing designations, including the existing Long Point and

Niagara Escarpment Biosphere Reserves, which could be linked later with an extended network of such sites.

A third concept involves identifying high quality areas that are being pressured by economic growth and directing concerted attention to develop coordinated, community-based programs that ensure development is sustainable in economic and environmental terms. A series of such sites throughout the Great Lakes basin, somewhat analogous to Areas of Concern, could provide a strong focus for long-term local efforts in pollution prevention within a comprehensive ecosystem approach. Such a program would exemplify the Agreement's purpose and objectives by broadening responsibility for the ecosystem and involving local and senior governments, industry, citizen groups and educational, cultural and service organizations, not to mention thousands of individuals, in a clearly delineated, agreed-upon framework for future development.

. . . THE PROGRAM DEVELOPED FOR SUCH HIGH QUALITY AREAS COULD . . . ENSURE PROTECTION AND SUSTAINABLE GROWTH IN THOSE AREAS NOT SUFFERING FROM SIGNIFICANT POLLUTION PROBLEMS; AND TO PROVIDE A FINAL GOAL OR PROCESS TO MAINTAIN WATER QUALITY IN RESTORED AREAS OF CONCERN.

This approach has been initiated in the Grand Traverse Bay region on Lake Michigan, site of our 1991 Biennial Meeting, where local development pressures threaten the high water quality of the bay. We are extremely impressed by the community's commitment to develop a model program, and support its desire to be the first area designated as a high quality or sustainable development area worthy of long-term protection.

We believe this third concept holds merit, in that the program developed for such high quality areas could serve two divergent but complementary purposes: to ensure protection and

sustainable growth in those areas not suffering from significant pollution problems; and to provide a final goal or process to maintain water quality in restored Areas of Concern. Once each area has completed Stage 3 of the Remedial Action Plan process, a program such as that developed for high quality areas could provide a valuable mechanism to ensure that restored water quality and beneficial uses are preserved.

The Commission recommends that:

11. **the Parties consider supporting, encouraging and cooperating in the identification and development of a UNESCO-MAB Biosphere Reserve proposal within the Lake Superior drainage basin as a means to further focus governmental, public, educational and scientific attention on preserving the high quality waters of Lake Superior;**

12. **the Parties join with jurisdictions and local governments in the identification and designation of sustainable development areas, and provide support under the Agreement's nondegradation policy to develop a model for conserving and protecting aquatic areas of high quality, including the Grand Traverse Bay region, within a framework of environmentally sensitive and sustainable economic development.**

Sustainable Development and the Great Lakes

Governments are challenged with a wide range of goals for the Great Lakes region, not all of which are necessarily compatible with protection of the biological, chemical and physical integrity of a lake system. While the Agreement is explicit in its requirement to implement programs to ensure that integrity, many human actions have been and continue to be inconsistent with it. Examples of these activities include incremental impairment of wildlife and — quite possibly — humans by toxic pollutants, the loss of critical ecosystem elements such as wetlands and endangered species, and the uncontrolled introduction of exotic species.

Ironically, persistent toxic substances seem to form the very essence of our modern existence, of our prosperity and lifestyles. Life without plastics,

A BALANCE BETWEEN ECONOMY AND ENVIRONMENT MUST BE STRUCK. PEOPLE HAVE NEW VALUES, AND FEEL STRONGLY THAT THE ENVIRONMENT CAN NO LONGER BE SEEN AS AN AFTERTHOUGHT, BUT MUST BECOME INTEGRAL TO OUR POLICIES AND DECISIONMAKING PROCESSES.

ROYAL COMMISSION ON THE FUTURE OF THE TORONTO WATERFRONT
PLANNING FOR SUSTAINABILITY,
JUNE 1991

fuels, petrochemicals and durable white paper simply seems unrealistic. The production, distribution and use of these goods are at the center of our regional, national and international economic viability, which has been and is under great strain. The need to protect and generate employment opportunities is compelling in current economic circumstances.

Long-term economic sustainability, including the existence of a healthy and creative work force, depends on a healthy environment. Paradoxically, a healthy environment depends on the existence of vibrant local and regional economies. It is therefore crucial that sufficient interdepartmental and intersectoral consultation among land use planning, economic development, natural resource and environmental agencies takes place to ensure cooperative decision-making to achieve both environmental and economic benefits. We do not believe that adequate interdepartmental cooperation has taken place, nor has it been sufficiently encouraged. Concern for environmental protection and, further, ecosystem integrity can no longer be the exclusive domain of environmental agencies and organizations.

A revitalized regional economy can either help or further stress a Great Lakes ecosystem already at risk. We urge that Governments at the federal, provincial/state and local levels, and the private sector, put into place consultative mechanisms to encourage economic development and revitalization that are consistent with and contribute to the goals of the Agreement.

Some programs may place certain industries at a comparative disad-

vantage to competitors in other regions where environmental requirements are less strict. The Commission suggests that, in order for the Great Lakes region not to fall behind other regions, economically or environmentally, Governments consider legislation or other appropriate mechanisms to ensure that Great Lakes jurisdictions do not suffer adverse, unfair economic consequences by virture of adhering to the provisions of the Agreement. These mechanisms are particularly relevant as an element of the pilot project for zero discharge of persistent toxic substances in the Lake Superior basin, and they are being investigated by our Virtual Elimination Task Force.

Our studies and consultations indicate that many people, including the business community, are aware of the need to modify behavior and are concerned about the long-term integrity of the ecosystem. Encouragement, or at the least the removal of disincentives, is needed in order for many sectors of our society to take action. We believe that Governments, in partnership with the private sector, have a unique opportunity to move towards the full implementation of the Agreement as a model for the new directions we must take into the 21st century.

The Future of the Great Lakes Water Quality Agreement

Article X of the Great Lakes Water Quality Agreement calls for the Parties to *"conduct a comprehensive review of the operation and effectiveness of th[e] Agreement following every third biennial report of the Commission..."*. The release of this, our *Sixth Biennial Report*, triggers that review. At the eighth meeting of the Parties in November 1991 pursuant to the 1987 Protocol Amending the 1978 Great Lakes Water Quality Agreement, it was concluded that *"...review should focus on how to improve implementation of the Agreement and not on changes to it."* We have received similar advice from our Great Lakes Water Quality Board and the interested public.

The Commission concurs. Fundamental changes are not needed. The Agreement's purpose, objectives and programs remain a firm foundation for the work that is needed to restore and maintain the Great Lakes Basin Ecosystem. The Agreement provides a legitimate framework for economic and social futures that are sustainable and supportive of human life and prosper-

ity. However, much remains to be done, and efforts should be directed toward implementing what the Parties have previously agreed to.

WE URGE GOVERNMENTS TO CONSIDER HOW THE SECOND GENERATION OF THE GREAT LAKES WATER QUALITY AGREEMENT AND ITS ACTIVITIES INCORPORATE THE VISION OF PARTNERSHIP IN A COMMON PURPOSE THAT THE GREAT LAKES, AND INDEED THE WORLD AND ALL HUMANITY, NOW DEMAND.

The Commission thus recommends that:

13. **the Parties not revise the Great Lakes Water Quality Agreement at this time; rather, in their forthcoming review, the Parties, in consultation with the Great Lakes States and Provinces, focus on how to improve programs and methods to achieve the requirements and overall objectives of the Agreement.**

The Parties should take into account our recommendations and comments contained in this and previous biennial and special reports during their review. In so doing, we urge Governments to consider how the second generation of the Great Lakes Water Quality Agreement and its activities incorporate the vision of partnership in a common purpose that the Great Lakes, and indeed the world and all humanity, now demand. In this spirit, we are pleased to reference, and encourage Governments to adopt, the vision statement for the Great Lakes proposed by the Great Lakes Water Quality Board in 1991:

"The Great Lakes watershed is a clean, safe environment where life forms exist in harmony. People take pride in the Great Lakes. We share and live an ethic which recognizes that environmental integrity provides the foundation for a healthy economy. We are secure in the knowledge that fish and wildlife are healthy to eat and the water can be enjoyed by all. We understand our responsibility for ensuring a self-sustaining Great Lakes ecosystem. This is the example we set for the rest of the world and the legacy we leave our children."

APPENDIX I

REPORTS PREPARED SINCE OCTOBER 1989 BY THE COMMISSION, ITS BOARDS AND INSTITUTIONS

International Joint Commission

Air Quality Trends in the Detroit-Windsor/Port Huron-Sarnia Region. [Washington, DC and Ottawa, Ontario], March 1992, 48 pp.

Special Report on Great Lakes Environmental Education. [Windsor, Ontario], May 1991, 20 pp.

International Joint Commission and Great Lakes Fishery Commission. *Exotic Species and the Shipping Industry: The Great Lakes-St. Lawrence Ecosystem at Risk.* [Windsor, Ontario], September 1990, 77 pp.

Fifth Biennial Report Under the Great Lakes Water Quality Agreement of 1978 to the Governments of the United States and Canada and the State and Provincial Governments of the Great Lakes Basin, Part I. [Washington, DC and Ottawa, Ontario], March 1990, 20 pp.

Fifth Biennial Report Under the Great Lakes Water Quality Agreement of 1978 to the Governments of the United States and Canada and the State and Provincial Governments of the Great Lakes Basin, Part II. [Washington, DC and Ottawa, Ontario], April 1990, 60 pp.

Great Lakes Water Quality Board

Summary of the Remedial Action Plan Forum. Based on a workshop held in conjunction with the IJC's 1991 Biennial Meeting, September 27-28, 1991 in Traverse City, Michigan. [Windsor, Ontario], 1992, 10 pp.

Great Lakes Water Quality Board. *Cleaning Up Our Great Lakes, A Report on Toxic Substances in the Great Lakes Basin Ecosystem.* 1991 Report on Great Lakes Water Quality to the International Joint Commission. [Windsor, Ontario], August 1991, 47 pp.

Sediment Work Group. *Register of Great Lakes Dredging Projects 1985 - 1989.* WP5.0. Document available only in 3-1/2" IBM compatible floppy disk. [Windsor, Ontario], July 1991.

Great Lakes Water Quality Board. *Review and Evaluation of the Great Lakes Remedial Action Plan Program 1991.* [Windsor, Ontario], June 1991, 50 pp.

Proceedings of the Mass Balance Workshop held in Barrie, Ontario March 7-9, 1990. Report of the Surveillance Subcommittee to the Great Lakes Water Quality Board. Windsor, Ontario, March 1991, 95 pp.

Stage 2 Remedial Action Plans: Content and Key Issues. A report of the Stage 2 RAP Workshop Steering Committee. Based on a workshop sponsored by the IJC's Water Quality Board, US EPA and Environment Canada, held on April 15-16, 1991 in Romulus, Michigan. [Windsor, Ontario], 1991, 32 pp.

Surveillance Work Group. *Toward a State of the Great Lakes Basin Ecosystem.* [Windsor, Ontario], 1991. (unpublished)

The Control of Discharges of Toxic Pollutants into the Great Lakes and Their Tributaries: Development of Benchmarks. Report to the International Joint Commission by Jeffery A. Foran. [Windsor, Ontario], 1991, 47 pp.

Sediment Work Group. *Register of Great Lakes Dredging Projects 1980 - 1984.* Report to the Great Lakes Water Quality Board. Windsor, Ontario, July 1990, 209 pp.

A Review of Lake Superior Water Quality with Emphasis on the 1983 Intensive Survey. Report to the Surveillance Subcommittee of the Great Lakes Water Quality Board. M.A. Zarull and C.J. Edwards, eds. Windsor, Ontario, March 1990, 220 pp.

Municipal Pretreatment Task Force. *A Review of Pretreatment Programs at Municipal Sewage Treatment Plants in the Great Lakes.* Report to the Great Lakes Water Quality Board. Windsor, Ontario, March 1990, 137 pp.

Proceedings of the Technology Transfer Symposium for the Remediation of Contaminated Sediments in the Great Lakes Basin, held in Burlington, Ontario, October 1988. Report to the Sediment Subcommittee of the Great Lakes Water Quality Board. Michael A. Zarull, Ed. Windsor, Ontario, March 1990, 180 pp.

Great Lakes Science Advisory Board

Great Lakes Science Advisory Board. *1991 Report to the International Joint Commission.* Windsor, Ontario, September 1991, 140 pp.

Proceedings of the Expert Consultation Meeting on Bald Eagles, February 12-13, 1990, Windsor, Ontario. Report of the Ecological Committee's Biological Effects Subcommittee to the Great Lakes Science Advisory Board. David A. Best, Michael Gilbertson and Holly Hudson, eds. [Windsor, Ontario], 1991, 33 pp.

Proceedings of the Expert Consultation Meeting on Mink and Otter, Windsor, Ontario, March 5-6, 1991. Sponsored by Environment Canada and Ontario Ministry of Natural Resources, hosted by the International Joint Commission. Ed Addison, Glen Fox and Michael Gilbertson, eds. [Windsor, Ontario], 1991, 26 pp.

An Ecosystem Approach to the Integrity of the Great Lakes in Turbulent Times, Proceedings of a 1988 Workshop. Supported by the Great Lakes Fishery Commission and the Great Lakes Science Advisory Board of the International Joint Commission. C.J. Edwards and H.A. Regier, eds. Ann Arbor, Michigan, July 1990, 300 pp.

Biological Surrogates of Mesotrophic Ecosystem Health in the Laurentian Great Lakes. Report to the Great Lakes Science Advisory Board by C.J. Edwards and R.A. Ryder. Windsor, Ontario, July 1990, 78 pp.

Technological Committee. *Technology for Reducing Organo-chlorines in Pulp Mill Effluents.* Report to the Great Lakes Science Advisory Board. Prepared by Paul Earl. Windsor, Ontario, June 1990, 32 pp.

Public Participation and Remedial Action Plans: An Overview of Approaches, Activities and Issues Arising from RAP Coordinator's Forums. Report of the Societal Committee of the Great Lakes Science Advisory Board. Windsor, Ontario, January 1990, 37 pp.

Integrated Pest Management in the Great Lakes Basin Ecosystem: A Review and Evaluation of Agricultural Programs. Prepared for the Great Lakes Science Advisory Board by Jeremy L. Higham. Windsor, Ontario, June 1990, 91 pp.

Ecosystem Objectives Committee. *Final Report to the Great Lakes Science Advisory Board.* Windsor, Ontario, March 1990, 58 pp.

Great Lakes Science Advisory Board. *Directory of Great Lakes Education Material.* Third Edition. Windsor, Ontario, December 1989, 77 pp.

Toward an Ethic for the Great Lakes Basin Ecosystem. A Discussion Paper Prepared for the Societal Committee of the Great Lakes Science Advisory Board by Jame Schaefer. Windsor, Ontario, November 1989, 28 pp.

Council of Great Lakes Research Managers

Council of Great Lakes Research Managers. *Great Lakes-St. Lawrence Research Inventory 1990/1991, Summary Report, September 1991.* [Windsor, Ontario], in preparation.

Council of Great Lakes Research Managers. *A Proposed Framework for Developing Indicators of*

Ecosystem Health for the Great Lakes Region. Report to the International Joint Commission. [Windsor, Ontario], July 1991, 50 pp.

Futures Workshop on Great Lakes 2000: Building a Vision, held in Niagara-on-the-Lake, Ontario, September 20-22, 1989. Part I: Summary Report. Report of the Council of Great Lakes Research Managers to the International Joint Commission. Windsor, Ontario, July 1990, 30 pp.

Futures Workshop on Great Lakes 2000: Building a Vision, held in Niagara-on-the-Lake, Ontario, September 20-22, 1989. Part II: Proceedings. Report of the Council of Great Lakes Research Managers to the International Joint Commission. Windsor, Ontario, July 1990, 103 pp.

Virtual Elimination Task Force

Virtual Elimination Task Force. *Persistent Toxic Substances: Virtually Eliminating Inputs to the Great Lakes*. Interim report. Windsor, Ontario, July 1991, 42 pp.

Related Reports

Great Lakes Educators Advisory Council. *Directory of Great Lakes Education Material*. Fourth edition. Windsor, Ontario, March 1992, 77 pp.

Detroit-Windsor/Port Huron-Sarnia Air Pollution Advisory Board. *Report to the International Joint Commission*. Toronto, Ontario and Lansing, Michigan, December 1990, 233 pp.

International Air Quality Advisory Board. *Second Regional Workshop on Integrated Transboundary Monitoring: Burlington, Vermont, February 6-8, 1989*. Washington, DC and Ottawa, Ontario, 1990, 130 pp.

International Lake Superior Board of Control. *Analysis of Impacts of Plan 1977-A*. April 1990, 18 pp. (unpublished)

International Lake Superior Board of Control. *Regulation of Lake Superior Plan 1977-A: Development, Description and Testing*. October 1989, 52 pp. (unpublished)

APPENDIX II

SUMMARY OF PUBLIC CONCERNS RAISED AT THE 1991 BIENNIAL MEETING

The Biennial Meeting leading to this *Sixth Biennial Report* was held in Traverse City, Michigan from September 29 through October 2, 1991. The meeting again attracted a record number of participants with divergent views and interests. The wide scope of attendance included local and basin residents as well as senior officials from the various state, provincial and national capitals, and from as far afield as the Soviet Union. The quality of discussion was enhanced by this diversity, including a significant representation from the business community for the first time in most sessions.

Participants had various opportunities to participate in a number of workshops, including one in French, on topics related to the technical reports of the Commission's advisory boards and task forces and on various Great Lakes - St. Lawrence River issues. An open public forum provided interested individuals with the opportunity to express their concerns directly to the Commissioners, both orally and through written submissions. For those who could not attend or wished to supplement their remarks, we also provided a period for written submissions after the meeting.

The concerns raised included incinerators, nuclear reactors, pulp and paper mills, toxic waste disposal, Lake Superior as a zero discharge demonstration area, public education and awareness, wetland and habitat protection, overpopulation, potable water, and landfill pollution. Many comments reiterated criticisms or suggestions made previously, while many others provided fresh perspectives. Within time constraints, as many people as possible were heard within an ambience of openness. As one participant said, *"We are speaking out and will continue to speak."*

Criticism was addressed towards Governments, various industrial interests, environmental advocacy groups and ourselves. Generally, participants at the public forum commended the Commission for our *Fifth Biennial Report* as well as our current process, but urged stronger, more directed analyses and recommendations to Governments.

Persistent Toxic Substances

The most prevalent theme was concern about persistent toxic substances and their effects on human and environmental health. During the public session, many speakers expressed frustration with the lack of any real progress towards zero discharge of persistent toxic substances under the Agreement. Many submissions were particularly concerned about chlorine and chlorine-containing compounds.

Not all submissions were in favor of the cessation of chlorine use. Several submissions, notably from persons involved in the business of water treatment, urged continued chlorination as the only effective means to provide safe drinking water. While it was acknowledged that organic compounds may combine with chlorine to produce small quantities of potentially harmful substances in the process of chlorinating water, it was suggested that the creation of potentially harmful substances could be prevented and that the public health benefits were overwhelmingly positive.

Several criticisms of chlorine use were directed at the pulp and paper industry, and particularly chlorinated organic compounds found in the effluent from bleached chemical pulp production. Some commentators felt that all organochlorines are persistent and toxic and therefore should be removed, pursuant to the terms under the Agreement, by eliminating the use of chlorine and chlorine-containing compounds from the production process. Substantial presentations from the pulp and paper and the chemical industries in both countries also addressed these issues. The industry positions challenged a number of assertions drawn from existing studies, including their scientific validity and the extrapolation of results.

Other submissions, while not focusing on any one particular persistent toxic substance, endorsed the spirit of the recommendations of the Virtual Elimination Task Force that persistent toxic substances should be restricted, phased out and ultimately banned.

Reduction and Waste Management

Several presentors focused their comments on the incineration of medical, hazardous and municipal waste which, they believe, releases persistent toxic substances such as dioxins and heavy metals in their most toxic and bioavailable form. Some felt incineration as a waste treatment approach is both unnecessary and contrary to the concept of zero discharge.

Others cited health problems such as cancer and leukemia among relatives and neighbors who live or work close to incinerators. Strong audience support was given to one public session participant who recommended a ban on all new waste incinerators, the sunsetting of current incineration as rapidly as possible, and the combination of the "3Rs": reduction, re-use and recycling.

Habitat/Heritage Areas

We were urged to call upon the Parties to strengthen the protection of islands and coastal areas within the Great Lakes basin. It was stated that there is a lack of basinwide inventories of and policies to protect wetlands and other sensitive coastal ecosystems. Islands and coastal areas generally were seen as primary targets for residential homes, marinas and other facilities that may not be developed in a sustainable manner in the Great Lakes ecosystem. Participants who attended the Heritage Area Workshop embraced the concept of protecting high quality natural areas and watersheds and strongly recommended that we become involved in these protection efforts.

Public Education and Community Awareness

Several participants reiterated the position that we should establish a citizens advisory board. They felt that the level of public consciousness, awareness, concern and commitment could make a significant contribution to our work under the Agreement.

It was noted that public health officials and medical professionals should become more aware of and educated about public concerns regarding health effects from exposure to persistent toxic substances, and that this sector of society was noticably absent from the Biennial Meeting. Increasing concern was expressed for human health issues believed to have their origins in environmental contaminants.

A number of concerns were raised in workshops on other topics, including spills and exotic species, global environmental trends, integrated monitoring, Remedial Action Plans, St. Lawrence River issues, the review of the Agreement, and our own priorities under the Agreement. In the last case, the participants endorsed the Commission's proposed Agreement priorities for the 1991-1993 biennial cycle and made some additional suggestions.

APPENDIX III

THE COMMISSION'S PROGRAM OF CONSULTATION, 1989-1991

The 1987 amendments to the Great Lakes Water Quality Agreement committed the Parties to take more fully and directly their responsibilities to coordinate and implement the Agreement. The assessment of progress has become the Commission's principal function under the Agreement. To carry out that assessment and develop recommendations, we are committed to receiving input from a widening range of sources. Thus, we have undertaken a number of actions over the past two years to enhance two-way communication between the Commission and a variety of Great Lakes interests.

It is our aim not only to make information on Agreement progress and problems available to the public, but also to receive input to our deliberations. We are convinced that such a process is valuable in helping to secure the broad understanding and support needed for the great challenges that lie ahead for Agreement progress. In our own experience, it strengthens the resolve of the Governments and allows all of us to develop better, more comprehensive yet strategically targeted advice and programs. While some may not feel that every element of our process has been open enough, we are committed to an evolving process that welcomes inputs and benefits from the broadest possible involvement.

Activities over the past two years include:

- A continuing, professional public information program that includes publication of the widely circulated periodical, *Focus on International Joint Commission Activities*, and creation and distribution of a variety of informational materials and publications.

- The Traverse City, Michigan, Biennial Meeting on Great Lakes Water Quality was attended by the largest and most diverse representation of the Great Lakes community to date, including senior officials from governments, industries and other organizations. Several opportunities for participants to

express their opinions to Commissioners were provided in plenary and workshop formats, as well as in the active local community program.

- Four focused roundtable discussions were held on zero discharge of persistent toxic substances, following an initial overview roundtable. These roundtables included representatives of the Commission, Governments, native and local communities, business and industry, and other nongovernmental organizations. We expect to continue these sessions on different topics in the years ahead.

- Successful integration of nongovernmental members on our various boards, committees and work groups. New members include individuals from nongovernmental organizations, business and industry, and other sources of expertise.

- A requirement to all Commission boards, councils and task forces, boundary wide, to hold at least one public meeting per year to inform citizens of their activities and receive input. Some groups have expanded this mandate, such as the series of public meetings held in 1991 by the Virtual Elimination Task Force, and the incorporation of public members in all levels of the Great Lakes Fluctuating Levels Study. A Citizens Advisory Committee is an active component of the levels study as well.

- Increased indepth and direct contact by individual Commissioners and the Commission as a whole with influential individuals in Government, industry, educational organizations and environmental organizations, as well as with our Boards and with the Remedial Action Plan committees.

- Direct encouragement by Commissioners to legislators and regulators to develop legislation and regulations consistent with the principles and objectives of the Agreement. This included presentations to Ministers, Governors, legislators, Congressional committees, and Conferences of Great Lakes Mayors in Milwaukee (1990) and northwest Indiana (1991), as well as to a number of other conference and public meetings.

- Increased efforts to serve the French-speaking population of Canada by preparation of additional reports and material in *Focus* in French, holding

a workshop in French at the Biennial Meeting and simultaneous translation for public meetings in designated bilingual areas of Canada.

- Issuance of the *Fifth Biennial Report on Great Lakes Water Quality* in record quantities, including Part I which reported specifically on the public's concerns as expressed at the Commission's Biennial Meeting in Hamilton, Ontario in November 1989.

- A *Special Report on Exotic Species*, co-authored with the Great Lakes Fishery Commission, described biological degradation of and challenges posed to the Great Lakes Basin Ecosystem as a result of the introduction of exotic species. Recommendations were aimed at reducing the future possibilities of unplanned introductions.

- A *Special Report on Great Lakes Environmental Education*, which included a series of specific recommendations to the Parties for programs at all age levels that, if adopted, would result in greater coordination of basinwide environmental education programs and serve as an international model.

- An expanded program to support the development and enhancement of Great Lakes and environmental education in the basin through the creation of an Educators Advisory Council. Commission staff work with council members to develop teacher training workshops and institutes, produce and distribute the *Directory of Great Lakes Education Material* to more than 40,000 educators in the region, and network with others to encourage further growth in environmental education generally.

- Sponsorship of *"Teachers Making a Difference,"* a live-by-satellite television conference that linked more than 30 sites and over 1,000 educators, parents, students and school administrators as participants. We are encouraging another such conference, "Preserving North America's Freshwater Resources," during 1992 as part of the activities linked to the United Nations Conference on Environment and Development in Brazil. This second teleconference is being planned by the United Nations Association of Canada and partners in Canada, the United States and Mexico as a trilingual conference for individuals in local communities to encourage the use of environmental education and to enhance understanding of protection of freshwater resources.

SUMMARY OF RECOMMENDATIONS

The Commission recommends that:

1. the Parties adopt and apply a weight-of-evidence approach to the identification and virtual elimination of persistent toxic substances.

2. the Parties expand the definition of persistent toxic substances to encompass all toxic substances:
   - with a half-life in any medium — water, air, sediment, soil or biota — of greater than eight weeks, as well as
   - those toxic substances that bioaccumulate in the tissue of living organisms.

3. the Parties sunset PCBs and seek public acceptance of the means to effect their destruction.

4. the Parties sunset DDT, dieldrin, toxaphene, mirex and hexachlorobenzene and, in particular, seek an international ban on their production, use, storage and disposal.

5. the Parties, in consultation with industry and other affected interests, alter production processes and feedstock chemicals so that dioxin, furan and hexachlorobenzene no longer result as byproducts.

6. the Parties review the use of and disposal practices for lead and mercury, and sunset their use wherever possible.

7. the Parties, in consultation with industry and other affected interests, develop timetables to sunset the use of chlorine and chlorine-containing compounds as industrial feedstocks and that the means of reducing or eliminating other uses be examined.

8. the Parties, in cooperation with Lake Superior states and provinces, establish a specific date at which no point source release of any persistent toxic substances will be permitted into Lake Superior or its tributaries.

9. the Parties, in cooperation with Lake Superior jurisdictions, agree to prohibit new or increased sources of point source discharges of persistent toxic substances; and establish a coordinated, planned phaseout of existing sources.

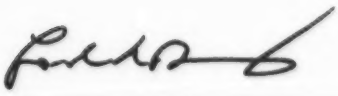
10. the Parties, in cooperation with Great Lakes jurisdictions, develop and implement educational programs that incorporate the Great Lakes and ecosystem considerations into existing curricula and educational programs at all age levels.

11. the Parties consider supporting, encouraging and cooperating in the identification and development of a UNESCO-MAB Biosphere Reserve proposal within the Lake Superior drainage basin as a means to further focus governmental, public, educational and scientific attention on preserving the high quality waters of Lake Superior;

12. the Parties join with jurisdictions and local governments in the identification and designation of sustainable development areas, and provide support under the Agreement's nondegradation policy to develop a model for conserving and protecting aquatic areas of high quality, including the Grand Traverse Bay region, within a framework of environmentally sensitive and sustainable economic development.

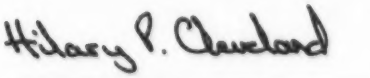
13. the Parties not revise the Great Lakes Water Quality Agreement at this time; rather, in their forthcoming review, the Parties, in consultation with the Great Lakes States and Provinces, focus on how to improve programs and methods to achieve the requirements and overall objectives of the Agreement.

Signed this 25th day of March 1992 as the Sixth Biennial Report of the International Joint Commission pursuant to the Great Lakes Water Quality Agreement of 1978.



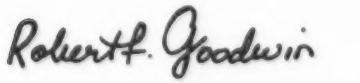
Gordon K. Durnil
Co-chairman

E. Davie Fulton
Co-chairman



Hilary P. Cleveland
Commissioner

Robert S.K. Welch
Commissioner



Robert F. Goodwin
Commissioner

Claude Lanthier
Commissioner

Cover Photo

In this year 1992, the observed quincentenary of the introduction of European culture into the culture of the Americas, this photo shows an immensity of water perhaps like the waters through which Columbus initiated that introduction. Of course, we can now observe the earth's water in detail from above, as was done by Arthur Tilley.
(FPG/Masterfile)

"Toxic substance means a substance which can cause death, disease, behavioural abnormalities, cancer, genetic mutations, physiological or reproductive malfunctions or physical deformities in any organism or its offspring, or which can become poisonous after concentration in the food chain or in combination with other substances."

AGREEMENT BETWEEN CANADA AND THE UNITED STATES OF AMERICA ON GREAT LAKES WATER QUALITY, 1978